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EFFECT OF RADIATION PROCESSES ON TRANSFER PHENOMENA IN PLASMA IN A STRONG MAGNETIC FIELD (USSR)

It is shown that absorption and emission of electromagnetic waves by plasma electrons in a strong magnetic field can influence transfer phenomena in plasma. In the case of stationary fields a mechanism for changing the photon distribution is necessary, which in plasma with "trapped" radiation is a reflection of em waves with the frequency $\sim \omega_H = eH/mc$, from the mirrors containing the plasma. If the transverse dimensions of a cylindrical mirror are much less than the mean free path of photons with this frequency, the transverse electrical conductivity of the plasma, as well as the transverse thermal conductivity resulting from radiation processes, is independent of mirror dimensions and is determined by the effective time between radiation collisions of electrons. When the effective intercollision time is much less than the mean coulomb relaxation time, radiation collisions, not coulomb collisions, will determine the transverse conductivity. In the case of alternating fields radiation processes can affect transport phenomena even in the absence of mirrors. [BB]

DISPERSION FUNCTIONS FOR REFRACTIVE INDEX AND ABSORPTION FACTOR IN MEDIA WITH EXCITON ABSORPTION (USSR)

A theoretical study considers spatial dispersion in isotropic media with exciton absorption. It is shown that the wider the bandwidth of exciton states the greater the effect of spatial dispersion on propagation of electromagnetic waves through the medium. For em waves with frequencies corresponding to exciton states (the condition necessary for spatial dispersion) additional transverse waves, characterized by a large refractive index and large absorption factor values, can form. The Kramers-Kronig dispersion relationships for the refractive index and the absorption factor are fulfilled only for ordinary transverse waves and yield infinite values, which no longer correspond to physical states, for additional transverse waves. It is noted that experimental measurement of the refractive index of the additional transverse waves must be made directly, as interferometric methods can be used only for ordinary transverse waves. The additional waves are rapidly damped and usually do not leave the medium. The results, though developed for isotropic media, are applicable to crystals for some directions of propagation. [BB]

INFLUENCE OF LOCAL PERTURBATIONS OF MAGNETIC FIELD ON CONTAINMENT OF PARTICLES IN MAGNETIC ADIABATIC TRAP (USSR)

Experiments conducted with the magnetic adiabatic trap "Ogrenok" show that local magnetic field perturbations attributable to the magnetic channel through which the fast ion beam is injected into the trap are responsible for part of the loss of fast ions in the mirrors and at the walls. These perturbations change by several degrees (> 3) the angle between the velocity vector and the direction normal to the line of force and also displace the Larmor centers of ions by distances on the order of the Larmor radius in the direction across the magnetic field. It was discovered that replacement of the magnetic channel by an electrostatic channel leads to a sharp decrease in the fast ion current loss in the mirrors and at the walls. No area is particularly advantageous for ion injection. Some scattering parameters were determined for fast ion scattering through local magnetic field perturbations by creating controlled local dipole-type perturbations. [BB]

DYNAMIC FRICTION AND DIFFUSION IN PLASMA (USSR)

t is shown that the study of slow, irreversible processes in plasma caused by the effect of long-range coulomb interactions can be reduced to the problem of particle diffusion in the velocity space treated by means of the Fokker-Planck equations. The coefficients of dynamic friction and diffusion participating in these equations are expressed in general form in terms of the spectral distribution of the longitudinal electric field in the plasma, under the assumption of an equilibrium condition. The results are then applied to the specific case of a quasi-equilibrium condition prevailing in a two-temperature plasma, with ion motion taken into account. These results are compared with expressions obtained earlier by other authors without accounting for ion motion. This motion has been found significant in friction and diffusion processes, mainly because of the ions' role in the mechanism of losses attendant upon electric field fluctuations, these losses constituting a large component of the total dynamic friction coefficient. The transverse component of the diffusion coefficient also depends substantially on ion motion. A similar treatment has also been applied to the case of equilibrium plasma in an external magnetic field. [JA]

AZIMUTHAL μ-MESON TELESCOPE (USSR)

An azimuthal μ-meson telescope has been installed at the cosmic-ray station of Kazakh State University for continuous recording of the directed intensity of the hard component. Each pair of the four identical sections which constitute the instrument records particles moving at the same zenith angle but from opposite azimuths, thereby insuring a double recording of the intensity from each direction. Each of three series of counters in a section contains four CИ-5Г counters in parallel. A lead screen 10 cm thick between the lower and middle series separates the hard component. Each series of counters has its own quenching circuit. The counter series are connected to a triple coincidence circuit, which is activated by signals with an amplitude $\geqslant 8$ v. The pulse from the coincidence circuit is taken first to the amplitude discriminator and then to the computer device, a Б-2 radiometer. The readings from the CБ-1M duplicating counter registers, set on the panel of the photorecorder of the neutron monitor, are recorded on photographic film every 5 to 15 min.   [DM]

PROPERTIES OF ABSOLUTELY STABLE SAMPLED-DATA AUTOMATIC SYSTEM (USSR)

A study is made of the absolute stability of a nonlinear sampled-data automatic system consisting of a nonlinear element whose characteristic satisfies certain conditions, and of a linear pulse part with stable characteristics. A definition of the absolute stability of such systems, similar to that for continuous systems, is given. It is stressed that analytic methods for studying stability are cumbersome when these systems are complex, and it is suggested that the graphoanalytic method and mathematical simulation be used for solution of the problem. Criteria for the absolute stability of such nonlinear systems are formulated in terms of conditions for the frequency characteristic of open and closed linear pulse parts and in terms of the parameter k_0 (the maximum value of the amplification factor). Certain properties of pulse characteristics of linearized systems are derived, on whose basis the graphoanalytic method for determining the absolute stability of these systems is outlined. The properties derived and criteria for absolute stability make it possible to establish the absolute stability of nonlinear sampled data automatic systems by simulation of linear pulse systems. No detailed discussion of the simulation problem is presented.   [LK]

The control object whose motion is described by the linear differential equation

$$\frac{dx}{dt} = Ax + b\,\xi, \tag{1}$$

where x is an n-dimensional vector in phase space; A, a matrix, b, a constant vector; and $\xi = \xi(t)$, a control function satisfying the condition $|\xi(t)| \leq 1$, is considered. The following problem is defined. From all admissible controls $\xi(t)$ it is necessary to find the optimal control which carries the object in a finite time T from the given position x_0 into a finite position $x_T = x(T)$ whose distance from the coordinate origin is minimal, i.e., to find such $\xi(t)$ for which the functional

$$R^2(\xi) = \sum_{1}^{n} x_i^2(T), \tag{2}$$

where $R(\xi)$, the length of the radius vector, is minimum. The landing problem of an airplane is studied as an illustration. To simplify the solution of the problem, it is assumed that the matrix A is diagonal and has distinct, real eigenvalues and that b is of the form $b = (1,1,\dots,1)$. By applying Pontryagin's maximum principle, the optimal control x is derived as a step function, has no more than n-1 switch points, and can be determined if the switch points and the terminal point of the trajectory are known. It is noted that attempts to establish the explicit expression for the switch instants in terms of elementary functions of the initial point were not successful, even in the case of two variables, but that it is possible to indicate domains where trajectories have k-1 (k $\leq$ n) switching points. For an object whose motion is described by a system of two equations, the solution of the problem is studied for cases when matrix A has real eigenvalues and when its eigenvalues are complex numbers. The structure of optimal trajectories is studied in detail, and the approximate solution of the problem is outlined.   [LK]

AUTHOR'S CERTIFICATE IN ELECTRICAL ENGINEERING (USSR)

V. S. Yakovlev, No. 150912. Magnetogasdynamic ac generator consisting of a synchronous-generator stator with a fixed core instead of a rotor and with electrodes placed in an annular chamber between the stator and the core. Discharges between the electrodes, which are moved along the chamber by a stream of gas, create an alternating pole system. Generator output and effective excitation-current utilization are increased by making the electrode movable along one side of the chamber and employing arc-type discharge between it and the fixed electrode on the other side.   [WP]

USE OF FIELD-EMISSION CATHODE IN MICROTRON (USSR)

Kanter, B. Z. In: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 11, Nov 1962, 1353-1356. S/048/62/026/011

In 1960 movable field-emission and thermionic cathodes were successfully used in a microtron at Tomsk Polytechnic Institute. To measure the spectrum, a beam of electrons accelerated in the resonator was "twisted" by a weak uniform magnetic field. A collector connected to an electrometer-amplifier and recorder moved along the line of orbit centers. The field-emission cathodes were cut from tantalum 0.2 mm thick in the form of blades and rings which could be moved 3 to 4 mm along the resonator axis. The thermionic cathodes were made of tungsten wires 0.1 and 0.15 mm thick. It was shown by the experiments that a 1-mm shift of the field-emission cathode along the resonator axis produces a twofold change in the collector current. At high operational temperatures, hf power injected into the resonator can be effectively used, because a widening current pulse causes the proportion of injected electrons to rise. In the same assembly it was possible to increase the current of the last orbit by two orders of magnitude, since the injection current could be regulated. The results prove that thermionic-emission cathodes can be used at relatively high pressures, provided the destructive action of ion bombardment is reduced by applying hf voltage and provided the cathode is sufficiently solid. [KM]

MEASUREMENT OF SMALL PHASE-MODULATION INDEXES (USSR)

Sheynman, D. I. Izvestiya vysshikh uchebnykh zavedeniy. Radiotekhnika, no. 5, 1962, 640-642. S/142/62/000/005

A special device for measuring the index of phase modulation in amplitude-modulated waves during their propagation in the ionosphere has been developed at the Novosibirsk Electrotechnical Institute of Communications. The method of measurement is based on comparison of the oscillation with the phase of an unmodulated reference signal. An am signal (160 cps) is applied to two channels. In the first the signal is filtered and carrier frequency oscillations are clipped, differentiated, and applied to a multivibrator to synchronize it. In the second the am effect is eliminated, and the oscillations, after clipping and differentiating, are used to synchronize a second multivibrator. Thus each multivibrator acts separately and in opposite phase upon the grids of the phase detector, where under certain operating conditions the plate current is proportional to the phase shift between the grids, i. e., to the phase-modulation index. The plate current is measured in the form of af voltage. The minimum value of the measured phase modulation index at an output-to-noise ratio of 10 is 0.005 rad. The measurements were carried out at night at two receiving points, one close to a powerful transmitting station where only ground waves were received, and the other at a distance of 150 km. The experiments showed that the phase modulation accompanying the amplitude modulation of the same transmitter has an index which exceeds by one order of magnitude that of the modulation expected from the ionospheric effect. At both points, however, practically similar indexes of the order of 0.03 rad were recorded. [KM]

NEW OXIDATION INHIBITOR FOR FUELS CONTAINING UNSATURATED HYDROCARBONS (USSR)

Gureyev, A. A., Z. A. Sablina, N. M. Silishchenskaya, Ye. P. Sobolev, S. M. Livshits, and A. P. Subbotin. Khimiya i tekhnologiya topliv i masel, no. 12, Dec 1962, 55-59.   S/065/62/000/012

A broad fraction of phenols referred to as "pyrolysate," obtained from wood tar by pyrolysis, has been found to inhibit oxidation and gum formation in gasoline, cracking kerosene, and diesel fuels during their oxidation and storage under laboratory conditions. Pyrolysate dissolved in benzene was added to the fuel, which was then subjected to oxidation by atmospheric oxygen at 100, 110, and 120°C in the presence of copper strips in airtight containers. Existent gum was determined by the steam-jet test. Oxidation inhibitor effectiveness was expressed as the difference between the increase in gum content in uninhibited and inhibited fuels. For example, after six hrs oxidation at 110°C the uninhibited gasoline A-72 showed 30 mg/100 ml of existent gum, while the same gasoline inhibited with 0.05% pyrolysate showed only 4 mg/100 ml. Pyrolysate was most effective at concentrations of 0.05 to 0.1%. It was established that although the addition of pyrolysate to the fuels raises their acidity, it does not increase their corrosiveness and does not contribute to deposit or carbon residue formation. Exposure of pyrolysate-inhibited gasoline to -50°C for three days does not cause precipitation or turbidity. Pyrolysate is superior to other Soviet oxidation inhibitors (e. g., Б) currently in use, and its cost is considerably lower than that of other wood tar oxidation inhibitors.   [TNM]

EXTRACTION OF Th AND Ce (IV) BY TRIBUTYL PHOSPHATE (USSR)

Nikolayev, A. V., and Yu. A. Afanas'yev. IN: Akademiya nauk SSSR. Doklady, v. 147, no. 6, 21 Dec 1962, 1380-1381.   S/020/62/147/006

The extraction by tributyl phosphate (TBP) of thorium and cerium (IV) nitrate simultaneously present in 1.5 N HNO_3 has been studied at the Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences USSR. Extraction was carried out in stoppered graduate cylinders. Calculation of the distribution coefficients of Th and Ce at various equilibrium concentrations of the metals in the aqueous phase indicated that in the organic phase Ce displaces Th. In the aqueous phase Th displaces Ce only at low $[Ce]_{aq}$ (~18g/l), at higher $[Ce]_{aq}$, e. g., > 40 g/l, Th has no effect on Ce extraction. Regardless of concentration, Th does not displace Ce in the organic phase. This mutual effect of Th and Ce is attributed to the substantially higher stability of the Ce solvate and holds true for TBP solutions in CCl_4 as well as for 100% TBP. It is concluded that Th and Ce are separable by TBP extraction. By suitable variation of concentration of TBP in CCl_4 and of Th and Ce in the aqueous phase, almost completely pure Ce or Th can be produced. In the extraction of thorium nitrate from monazite treatment products, addition of H_2O_2 to reduce Ce(IV) ions increases both the purity and recovery of Th.   [SVM]